

Description of *Elisesione imajimai* sp. nov. From Japan (Annelida: Hesionidae) and A Redescription of *E. problematica* (Wesenberg-Lund, 1950) and Its Confirmation Within Hesionini

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(Received 8 July 2017; Accepted 27 January 2018; Published 14 February 2018; Communicated by James D. Reimer)

Citation: Jimi N, Eibye-Jacobsen D, Salazar-Vallejo SI. 2018. Description of *Elisesione imajimai* sp. nov. from Japan (Annelida: Hesionidae) and a redescription of *E. problematica* (Wesenberg-Lund, 1950) and its confirmation within Hesionini. Zool Stud 57:8. doi:10.6620/ZS.2018.57-08.

Naoto Jimi, Danny Eibye-Jacobsen, and Sergio I. Salazar-Vallejo (2018) *Elisesione imajimai* sp. nov. is newly described based on specimens collected in Sagami Bay, Japan, at a depth of 150-250 m. This new species resembles *E. problematica* (Wesenberg-Lund, 1950) from Iceland, but differs because in *E. imajimai* sp. nov. the ventral cirri surpass the tips of the neurochaetal lobes, reaching to the medial part of the neurochaetal bundle; the palps are $1/2-2/5$ as long as the antennae; the aciculae are pale brownish; and the dorsal integument shows 9-10 transverse wrinkles per segment, whereas in *E. problematica* the ventral cirri hardly reach the tips of the neurochaetal lobes; the palps are as long as the antennae; the aciculae are black; and there are 15 transverse wrinkles per segment. A morphological redescription of *E. problematica* based on its type material and a revised key to identify species in the genus are also provided. A phylogenetic analysis based upon four genes (COI, 16S, 18S, 28S) confirms its position within Hesionini.

Key words: *Hesionella*, *Wesenbergia*, Hesionini, Polychaeta, Sagami Bay.

BACKGROUND

Elisesione Salazar-Vallejo, 2016 was recently proposed as a replacement name for *Wesenbergia* Hartman, 1955 because the latter is a junior homonym of a hymenopterid genus. *Elisesione* includes two valid species: *E. mezianei* Salazar-Vallejo, 2016 and *E. problematica* (Wesenberg-Lund, 1950), the type species. This genus is distinguished from other hesionid genera by having the following features: 21 segments, 16 chaetigers, eight pairs of tentacular cirri, two pairs of cephalic appendages (simple palps and

antennae), bidentate neurochaetae, and pharynx without marginal papillae (Plejdel 1998; Salazar-Vallejo 2016). The species are distributed from shallow (*E. mezianei*: 27-37 m) to deeper waters (*E. problematica*: 550 m) in widely separated localities in the central Pacific (Wallis Island) and the North Atlantic (Iceland).

In Japan, another species of *Elisesione* was reported as *Wesenbergia problematica* by Imajima (2003 2007) based on specimens collected in Sagami Bay by the late Emperor Showa. Emperor Showa collected a large amount of marine organisms, and the polychaetes were reported by

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the late Dr. Minoru Imajima (Imajima 1997 2003). Salazar-Vallejo (2016) described the second species of *Elisesione* and indicated that the Japanese specimens differed from *E. problematica* because they have palps half as long as the antennae, parapodia with the dorsal cirrophores twice longer than wide, acicular lobes single, and neurochaetal blades that are 7-9 times longer than wide and have guards.

In this contribution, after having studied Imajima's specimens and an additional living specimen, we describe them as a new species, *E. imajimai* sp. nov., and redescribe *E. problematica* based on the type specimen. We also evaluate the phylogenetic position of *Elisesione* among Hesionidae and confirm its position within Hesionini (Pleijel 1998).

MATERIALS AND METHODS

Worms that were used for the new species description were dredged at two sampling stations in Sagami Bay: Station 1 (St. 1) was sampled by Emperor Showa, 35°07.0'N, 139°34.3'E to 35°07.3'N, 139°34.2'E, at a depth of 150-250 m, on 3 June 1960. The water depth indicated by Imajima (2003, 2007; 150-320 m) differs from that on the label accompanying the specimens. Station 2 (St. 2) was sampled by one of us (NJ), 35°07'N, 139°34'E to 35°06'N, 139°34'E, at a depth of 150-201 m, on 16 February 2017.

Specimens from St. 1 were preserved in ethanol and stored at the Showa Memorial Institute, National Museum of Nature and Science, Tsukuba (NSMT; collections were transferred to Tsukuba from Tokyo in 2012 and the acronym remains unaltered). The fixative was not indicated, but it was probably formalin. The specimen from Sagami Bay St. 2 was fixed and preserved in 70% ethanol, and has also been deposited in NSMT.

The holotype of *E. problematica* that is deposited in the collections of the Zoological Museum, Natural History Museum of Denmark (ZMUC), Copenhagen was used for redescription.

The specimens were observed with stereo microscopes and photographs were made with digital cameras. Measurement data for *E. imajimai* sp. nov. are in table 1.

DNA extraction, sequencing, alignment, and removing ambiguous positions for *E. imajimai* sp. n. were carried out following the method detailed in Jimi and Fujiwara (2016). Additional sequences of other hesionid species were obtained from GenBank (Table S1). The sequences of the four genes, COI, 16S, 18S, 28S, were concatenated using Kakusan (Tanabe 2007), which recommended a GTR + G evolutionary model for each gene. A phylogenetic tree was constructed using the maximum likelihood (ML) method with RAxML-VI-HPC (Stamatakis 2006). The robustness of the ML tree was evaluated by 1000 bootstrap pseudo-replicates (-f option). Newly obtained sequences were deposited in the DNA Data Bank of Japan (DDBJ No. LC361352-LC361354); these sequences are available from GenBank.

RESULTS

TAXONOMY

Family Hesionidae Grube, 1850
[Japanese name: Otohime-gokai-ka]
Subfamily Hesioninae Grube, 1850
Tribe Hesionini Grube, 1850
Elisesione Salazar-Vallejo, 2016
[New Japanese name: Elise-otohime-gokai-zoku]

Elisesione imajimai sp. nov.

(Figs 1-2)

urn:lsid:zoobank.org:act:A2AFFD68-4E59-45B0-A1EA-DB08BEFA7747

[Japanese name: Noumen-otohime-gokai]

Wesenbergia problematica: Imajima 2003: 138-139, fig 81; Imajima 2007: 450, fig 143.

Elisesione problematica sensu Imajima 2003: Salazar-Vallejo 2016: 5.

Description: Holotype 25 mm long, 3 mm

Table 1. Measurements of *Elisesione imajimai* sp. nov. specimens

Specimen	Body length	Body width	Antenna length (longest)	Palp length (longest)	Tentacular cirrus length (longest)
NSMT-Pol H-665	25 mm	3 mm	70 μ m	40 μ m	2 mm (broken)
NSMT-Pol R: 604-1	30 mm	3 mm	200 μ m	100 μ m	4 mm
NSMT-Pol R: 604-2	34 mm	4 mm	130 μ m	100 μ m	5 mm

wide (by chaetiger 7, without parapodia), with 16 chaetigers (right parapodium of chaetiger 5 removed, kept in 2.0 ml plastic tube with holotype; right parapodia of chaetigers 5-7 and 11 removed from paratypes by Dr. Minoru Imajima, kept in

glass vial with type specimens).

Body cylindrical, tapered in posterior region (Figs. 1A, B), dorsally pinkish and ventrally whitish in life, whitish in ethanol, dorsal integument annulated, with 9-10 transverse wrinkles per

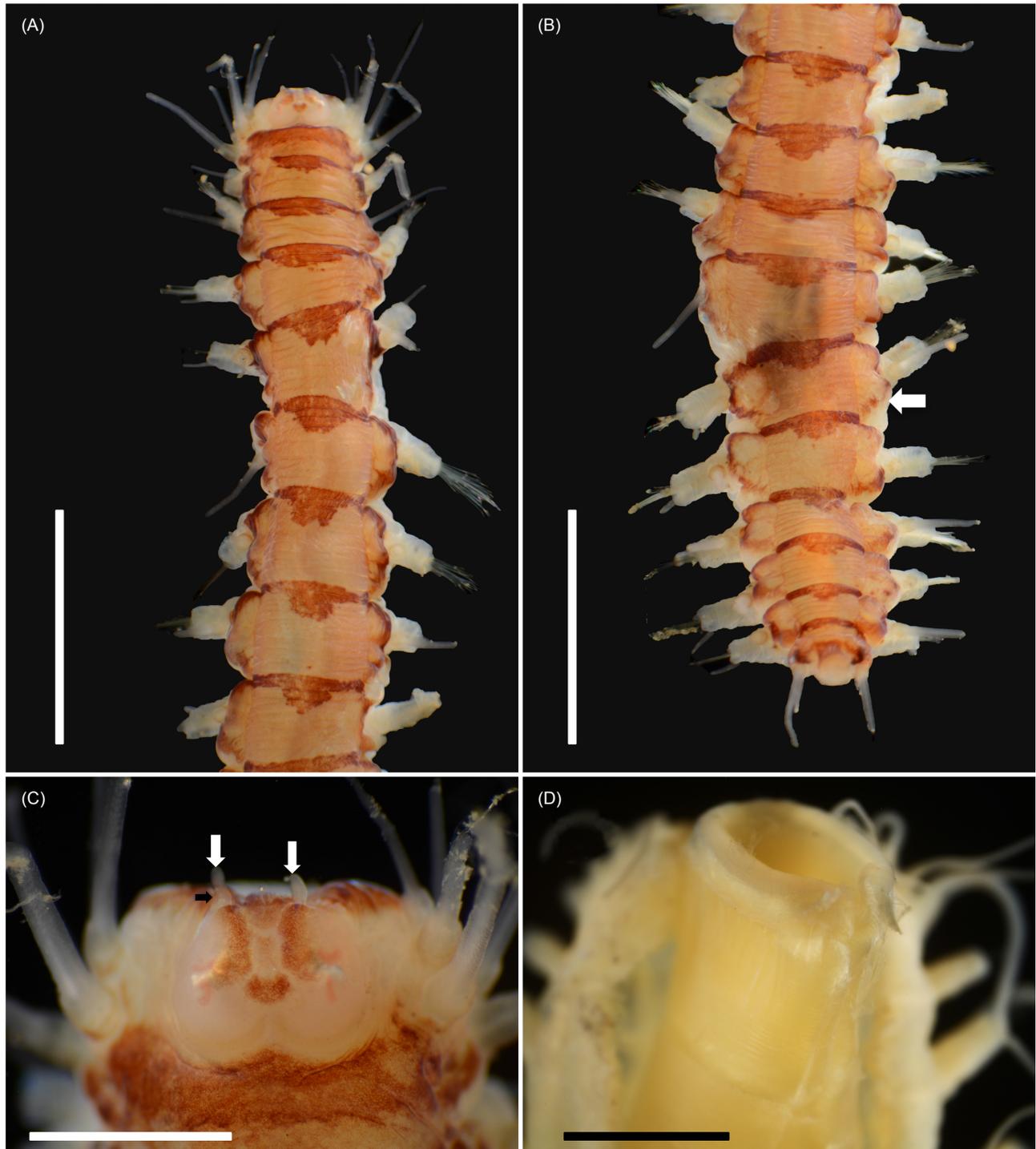


Fig. 1. *Elisesione imajimai* sp. nov., A-C, holotype (NSMT-Pol H-665); D, paratype (NSMT-Pol R: 604-2). (A) anterior end, dorsal view; (B) posterior end, dorsal view (arrow points to a lateral cushion); (C) prostomium, dorsal view (white arrows point to tips of antennae, black arrow points to left palp); (D) pharynx, ventral view. Scale bars: A-B = 5 mm; C = 3 mm; D = 2 mm.

segment (Figs. 1A, B). Reddish brown transverse bands and longitudinal marginal lines present along each segment in living specimen over a pale brown background (Figs. 1A, B). Transverse bands irregular, straight, homogeneous on chaetiger 1, across last segment and pygidium, other segments with transverse bands straight across their anterior margin, posterior margin of band projected posteriorly into irregular semicircular

areas. Tentacular cirri, dorsal cirri and parapodial lobes whitish. Pigmentation of paratypes unknown (specimens in ethanol for over 50 years).

Prostomium wider than long, median line with a shallow depression, lateral margins rounded, slightly wider medially (Fig. 1C). Antennae digitate. Palps simple, blunt, shorter than antennae ($1/2-4/5$ times as long as antennae), positioned at same level, slightly external to antennae (Fig. 1C). Eyes

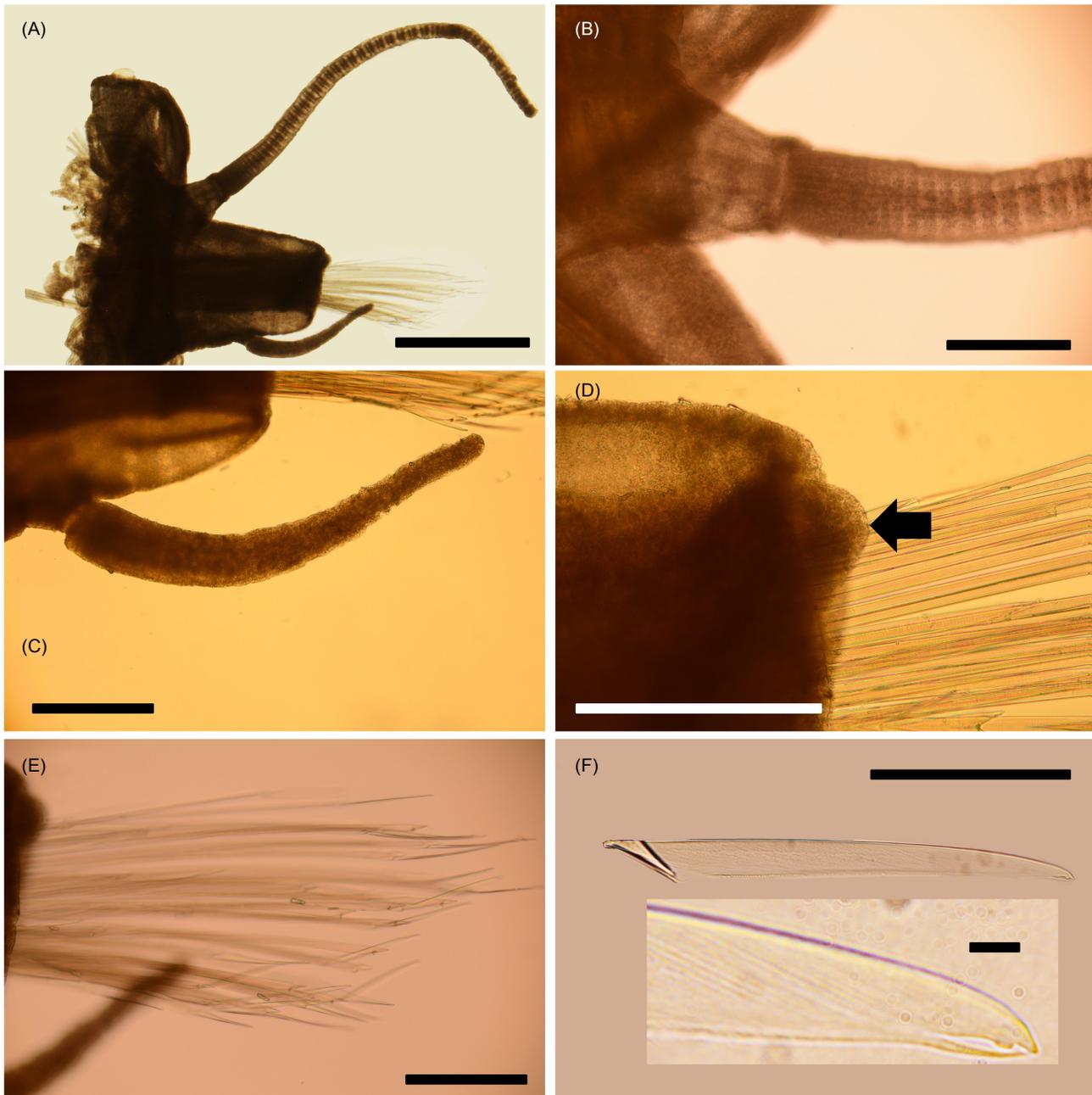


Fig. 2. Parapodial features of *Elisesione imajimai* sp. nov., A-F, paratype (NSMT-Pol R:604-2), chaetiger 5, right parapodium, posterior view. (A) parapodium; (B) dorsal cirrophore; (C) ventral cirrus; (D) acicular lobe (arrow points to tip of acicular lobe); (E) neurochaetal bundle; (F) blade of ventral neurochaeta (inset: tip of blade). Scale bars: A = 1 mm; B-E = 300 μ m; F = 100 μ m; F (inset) = 5 μ m.

present, two pairs, pinkish in living specimen, anterior eyes with pigmented areas transverse half-moon shaped, in posterior ones vertical (Fig. 1C).

Tentacular cirri long, thick, longest one reaches chaetiger 3 in paratype. Lateral cushions low, barely projected dorsally, slightly projected laterally, undivided (Figs. 1A, 1B).

Parapodia with chaetal lobes cylindrical, truncate, longer than wide (Fig. 2A); dorsal cirri thick, cirrophores cylindrical, smooth, 1.5-2 times longer than wide (Fig. 2B), cirrostyle basally cylindrical, smooth, annulated medially and distally, shorter than body width without parapodia. Ventral cirri basally smooth, rugose medially and distally, surpassing neurochaetal lobe, reaching up to half length of neurochaetal bundle (Fig. 2C).

Acicula pale brownish, tapered; acicular lobe single, blunt, rounded (Fig. 2D). About 35 neurochaetae per bundle (Fig. 2E), shaft and blade pale brownish, blades 7-10 times longer than wide, with subdistal tooth $\frac{1}{3}$ - $\frac{1}{2}$ times as long as apical tooth, guard approaching apical tooth (Fig. 2F).

Posterior region barely thinner than median region. Cirri of prepygidial segment broken; pygidium smooth, depressed; anus dorso-terminal, open, with two pairs of lateral anal cirri (Fig. 1B) and about 8 anal papillae.

Pharynx dissected in paratype, smooth; dorsal papilla not seen, terminal papillae absent (Fig. 1D).

Paratype with oocytes in coelom, visible along chaetigers 6-14, each oocyte 300-500 μ m in diameter, whitish in ethanol, about 150 oocytes per segment.

Type material: Holotype (NSMT-Pol H-665), sex unknown, Sagami Bay St. 2 (150-201 m depth, 35°07'N, 139°34'E to 35°06'N, 139°34'E). Paratype (NMST-Pol R:604-1), Sagami St. 1 (150-250 m depth, 35°07.0'N, 139°34.3'E to 35°07.3'N, 139°34.2'E), 30 mm long, 3 mm wide, mature female; paratype (NSMT-Pol R: 604-2), Sagami St. 1, 34 mm long, 4 mm wide, sex unknown.

Sequence: Partial sequence of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene, 629 bp; 18S rRNA (18S) gene, 1713 bp; 28S rRNA (28S) gene, 982 bp, extracted from holotype specimen deposited in DDBJ (No. LC361352-LC361354). 16S rRNA gene could not be determined.

Etymology: This species is named in honour of Dr. Minoru Imajima, in recognition of his great contributions to polychaete taxonomy in Japan.

Distribution: Only known from the type locality

(Sagami Bay, Japan), 150-250 m depth.

Remarks: *Elisesione imajimai* sp. nov. resembles *E. problematica* (Wesenberg-Lund, 1950, see below) because they have single acicular lobes and dorsal cirrophores that are about twice longer than wide. They differ in the length of the ventral cirri, size of palps, colour of aciculae, and the number of dorsal transverse wrinkles per segment.

In *E. imajimai* sp. nov. the ventral cirri surpass the neurochaetal lobe tip, the palps are $\frac{1}{2}$ - $\frac{4}{5}$ times as long as the antennae, the aciculae are pale brownish, and the dorsal integument has 9-10 transverse wrinkles per segment, whereas in *E. problematica* the ventral cirri hardly reach the tip of the neurochaetal lobe, the palps are as long as the antennae, the aciculae are black, and there are 13-15 transverse wrinkles per segment (Wesenberg-Lund 1950).

Furthermore, the neurochaetal blades of *E. imajimai* sp. nov. are 7-10 times longer than wide, whereas in *E. problematica* they are larger (8-12 times longer than wide). This feature was used in the discrimination of the two species in Salazar-Vallejo (2016), but the range difference cannot be regarded as diagnostic because of the small number of specimens currently known, and especially because of the few chaetae remaining in the holotype of *E. problematica*.

On the other hand, the finding of very large oocytes in the new species deserves two additional comments about some interesting features. First, egg size is to some degree related to dispersal potential. Strathmann (1977:373) simplified the mathematical models of Richard Vance, proposed a few years before, by indicating that "an increase in egg size is associated with... a decrease in the duration of the period between fertilization and metamorphosis." Second, large eggs usually undergo lecithotrophic development. Wray and Raff (1991:48) and Giangrande et al. (1994:310) correlated egg size and developmental mode in echinoids, and indicated that species having eggs of about 300-500 μ m have lecithotrophic larvae, whereas those having eggs about 600-1000 μ m have highly derived lecithotrophic larvae. Schroeder and Hermans (1975) also indicated that if polychaete eggs are larger than 180 μ m in diameter, the young develop directly into juveniles without an intervening stage. These larvae/juveniles usually spend a short period in the water column. These two features, combined with the low abundance of the species throughout their distribution range, could explain why the known

species ranges are so restricted, confined in most instances to single localities.

***Elisesione problematica* (Wesenberg-Lund, 1950)**
(Figs 3-4)

Hesionella problematica Wesenberg-Lund, 1950: 14-15, fig. 15.

Wesenbergia problematica: Hartman 1955: 41.
Wesenbergia problematica: Pleijel 1998: 112-113, fig. 9.
Elisesione problematica: Salazar-Vallejo 2016: 3-5.

Description: Holotype about 50 mm long, 8 mm wide, 16 chaetigers. Body cylindrical, tapered in posterior region (Figs. 3A, B), brownish

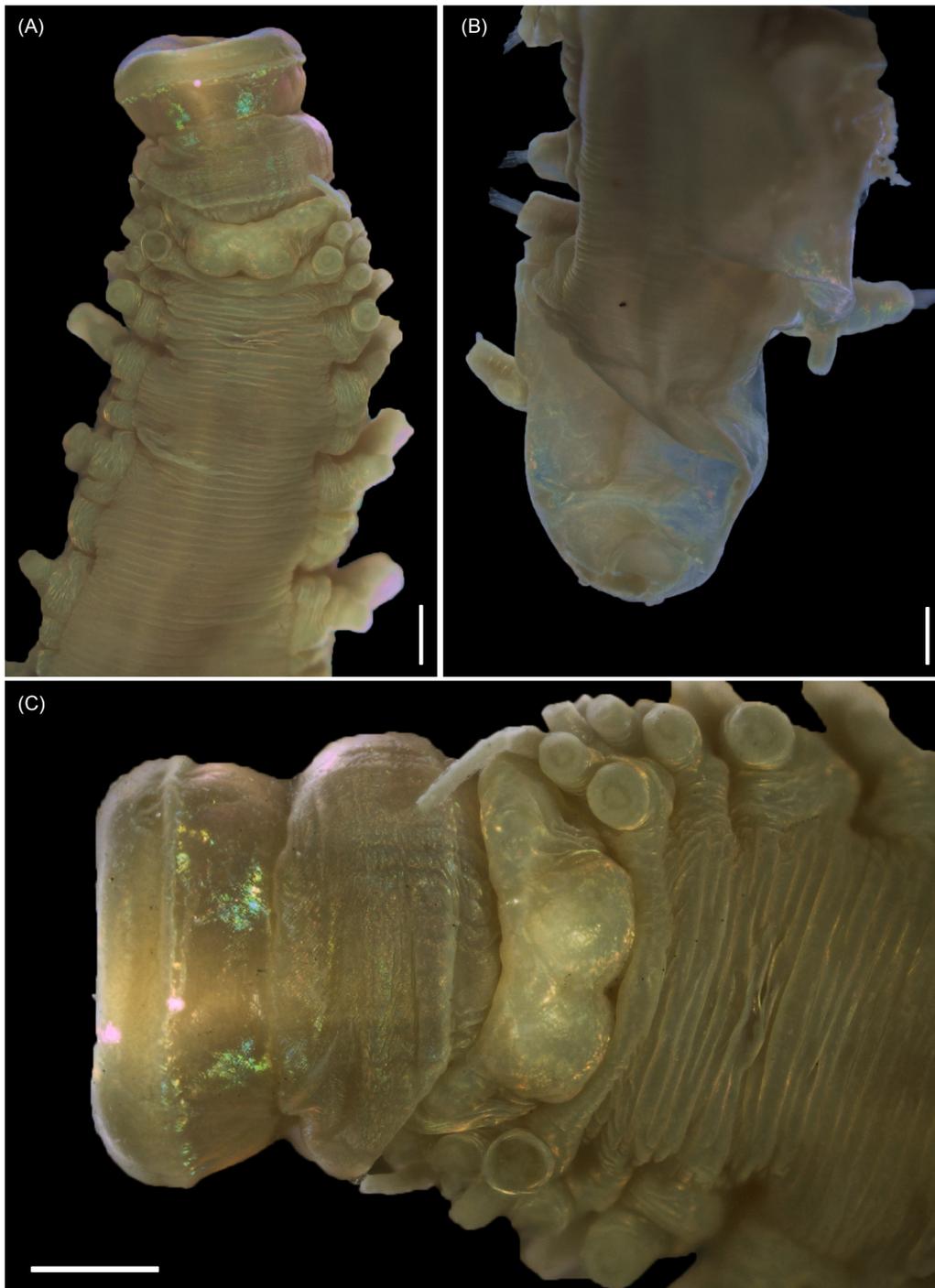


Fig. 3. *Elisesione problematica* (Wesenberg-Lund, 1950), holotype (ZMUC-POL-480). (A) anterior end, dorsal view; (B) posterior end, dorsal view; (C) head, dorsal view. Scale bars: A-C= 1 mm.

in ethanol, dorsal integument annulated, with 13-15 transverse wrinkles per segment (Figs. 3A, B, C). Tentacular cirri, dorsal cirri and parapodial lobes whitish. Pigmentation of holotype unknown (specimens in ethanol for over 55 years before description; now darker).

Prostomium wider than long, median line with a shallow depression, lateral margins rounded, wider medially (Fig. 3C). Eyes not seen. Palps and antennae present, damaged; palps ventral, slightly more lateral than antennae; left antenna present, tip damaged; right antenna missing (in the original illustration, palps and antennae tapered, of similar length). Tentacular cirri long, thick. Lateral cushions low, slightly projected laterally, divided in 2-3 parts (Figs. 3A, C).

Parapodia with chaetal lobes cylindrical, truncate, longer than wide (Fig. 4A); dorsal cirrophores cylindrical, smooth, about $\frac{4}{5}$ times

as long as wide (Fig. 4B). Ventral cirrophore cylindrical, smooth, as long as wide (Fig. 4C). Ventral cirri smooth, not reaching tip of neurochaetal lobe (as indicated in original illustration).

Acicula black, tapered; acicular lobe single, blunt, digitate. About 25 neurochaetae per bundle (Fig. 4D), shaft and blade pale brownish, blade 8-12 times as long as wide, with subdistal tooth as long as apical tooth, guard approaching apical tooth (Fig. 4E).

Posterior region tapered into a blunt cone; body wall macerated (Fig. 3B). Cirri of prepygidial segment broken; pygidium smooth, depressed; anus dorso-terminal, open, with two pairs of lateral anal cirri.

Pharynx smooth, partially everted, basal ring barely exposed, dorsal papilla not exposed, terminal papillae absent (Figs. 3A, C).

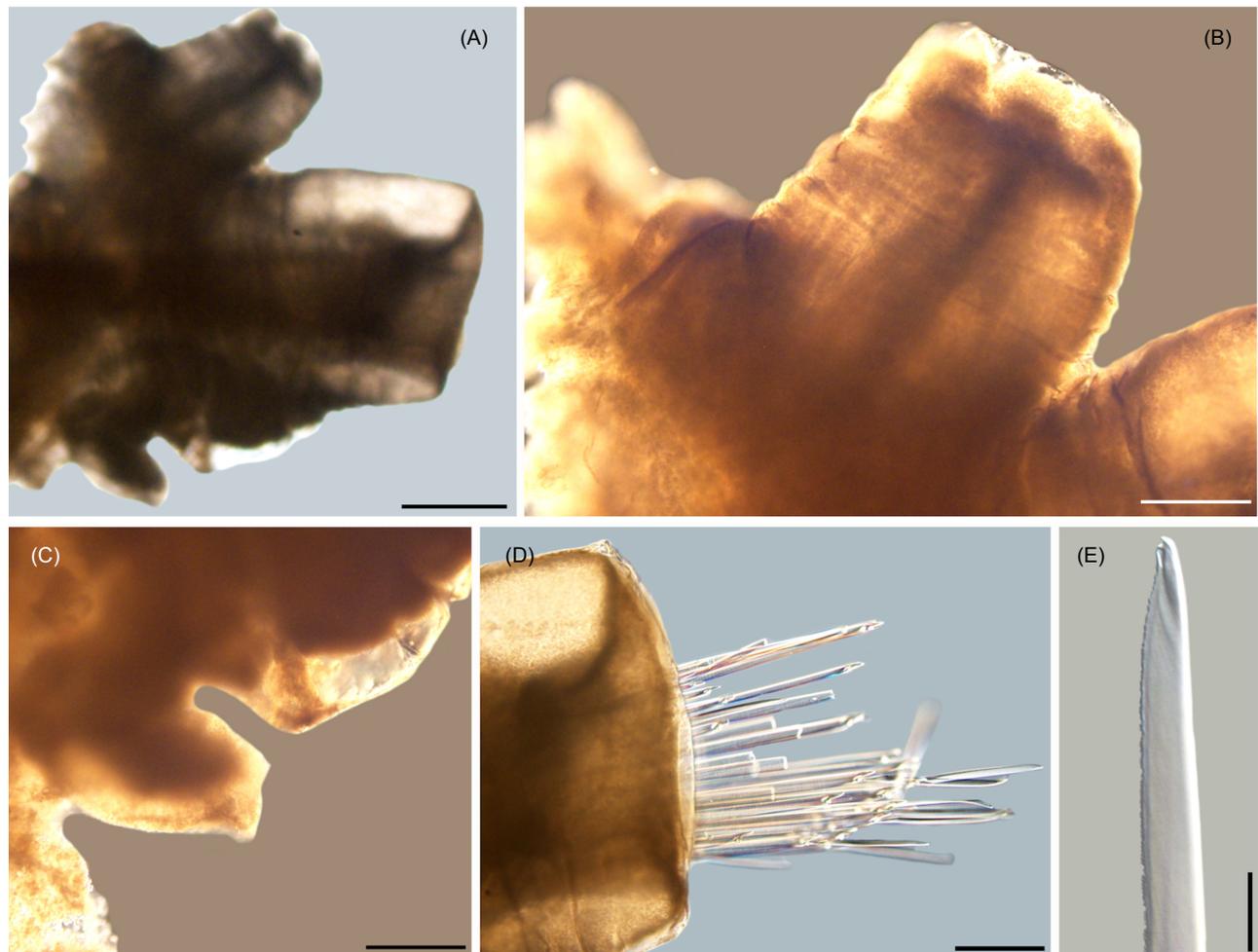


Fig. 4. *Elisesione problematica* (Wesenberg-Lund, 1950), holotype (ZMUC-POL-480). (A) chaetiger 5, right parapodium, posterior view (chaetae omitted); (B) same, dorsal cirrophore; (C) same, ventral cirrophore; (D) same, neurochaetae; (E) same, tip of ventral neurochaetal blade. Scale bars: A = 0.5 mm; B-D = 0.2 mm; E = 20 μ m.

Type material: Holotype (ZMUC-POL-480), sex unknown. Southwest off Iceland (555 m depth, 64°18'N, 27°00'W).

Distribution: Only known from the type locality, southwest off Iceland, 555 m depth.

Phylogenetic analysis

In the resulting tree, *Elisesione*, *Hesione*, and *Leocrates* are reciprocally monophyletic, with high support value (86% bootstrap support [BS]). *Elisesione* is sister to *Leocrates*, although they comprise a poorly supported clade (52% BS) (Fig. 5).

In a previous morphological study, *Elisesione*, *Hesione*, and *Leocrates* were monophyletic and regarded as tribe Hesionini (Pleijel 1998). Our results based on four genes also supported the tribe as monophyletic. In Pleijel's paper, *Elisesione* is sister to *Hesione*; this is not in agreement with

our results. However, the BS value of the clade is poor (52% BS); hence, additional study is needed to clarify the position of *Elisesione* in the clade Hesionini.

Key to species of the genus *Elisesione* (modified from Salazar-Vallejo 2016)

- 1 Acicular lobe single; parapodia with dorsal ceratophores about twice longer than wide; neurochaetal blades with guards 2
- Acicular lobe double; parapodia with dorsal ceratophores 4-5 times longer than wide; neurochaetal blades 1-3 times longer than wide, without guards (palps about 2/3 as long as antennae) *E. mezianei* Salazar-Vallejo, 2016
- 2 Acicula black in ethanol; palps as long as antennae; ventral cirri hardly reach tips of neurochaetal lobes *E. problematica* (Wesenberg-Lund, 1950)
- Acicula pale brownish in ethanol; palps 1/2-4/5 times as long as antennae; ventral cirri surpass neurochaetal lobe tips *E. imajimai* sp. nov. This study

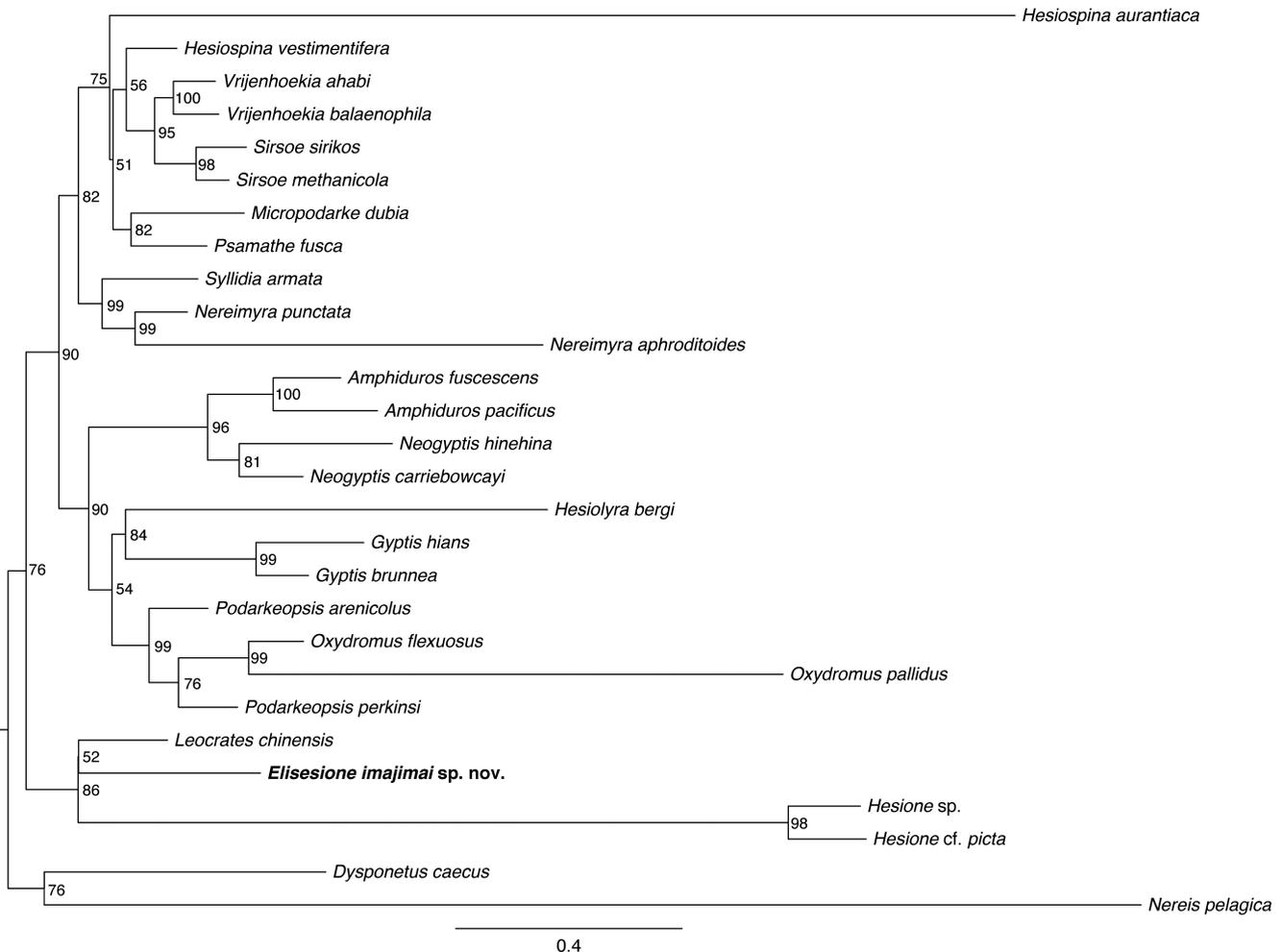


Fig. 5. Phylogenetic tree of Hesionidae based on COI, 16S, 18S and 28S sequences. *Dysponetus caecus* and *Nereis pelagica* were used as an 'outgroup'. Nodal support values (Maximum-likelihood (ML) bootstrap support [BS] value) are indicated on each branch.

Acknowledgments: This work and the new species name have been registered with ZooBank under urn:lsid:zoobank.org:pub:78E86A7D-C120-4580-8459-82D50DF965C2. We thank Dr. Hiroshi Namikawa and Dr. Hironori Komatsu (NSMT), who kindly allowed us to study the specimens of *Elisesione imajimai* sp. nov. collected by Emperor Showa. We also thank Dr. Hiroshi Kajihara (Hokkaido University) for his kind help with loaning samples; Messrs. Mamoru Sekifuji, Hisanori Kohtsuka and Dr. Akihito Omori (University of Tokyo), Dr. Hiroaki Nakano and Mr. Yasutaka Tsuchiya (University of Tsukuba), and all the other participants in the 12th Japanese Association for Marine Biology (JAMBIO) Coastal Organism Joint Survey held at Misaki, for their generous help in collecting additional material. This study was partly supported by JAMBIO and JSPS KAKENHI no. 17J05066.

Authors' contributions: NJ and SISV designed the study and drafted the manuscript. NJ and DEJ conducted the morphological analysis. NJ conducted the phylogenetic analysis. All authors read and approved the final manuscript.

Competing interests: The authors declare that they have no conflict of interest.

Availability of data and materials: The manuscript has been incorporated in ZooBank. Materials are deposited in the collections of NSMT.

Consent for publication: Not applicable.

Ethics approval consent to participate: Not applicable.

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Supplementary material

Table S1. List of hesionid and outgroup species included in the phylogenetic analysis, together with GenBank accession numbers (download)